REMARKS

I. Introduction

This is in response to the Office Action dated July 30, 1999. No extension of time is believed to be necessary for the filing of this Amendment, but if an extension of time is required, applicants request that this be considered a petition therefor. The Commissioner is hereby authorized to charge any fees which may be required for such an extension to Deposit Account No. 11-1158.

Applicants have noted the Examiner's statement on page 2 of the Office Action that the drawings submitted on December 1, 1998 have been approved by the Official Draftsperson. The PTO-948 form referred to by the Examiner, however, was not included with the Office Action. Applicants would appreciate receiving a copy of that form so that their file for this application will be complete.

II. The §102 Rejection

In the July 30th Office Action, the Examiner rejected applicants' Claims 51 and 53 under 35 USC § 102(b) based on Chu et al., "Multilayer dielectric materials of $SiO_x/Ta_2O_3/SiO_2$ for temperature stable diode lasers," Materials Chemistry and Physics, Vol. 42, pages 214-216, 1995 (the "Chu et al. reference"). Applicants respectfully traverse this rejection.[1]

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[1] Applicants do not believe that the Chu et al. reference is, in fact, 102(b) art against the present application. On page 214, the article states that it was accepted for publication on May 3, 1995. The present application claims priority from provisional application number 60/010,058, filed January 16, 1996. Accordingly, applicants believe that the Examiner has not established that Chu et al. is 102(b) prior art. The distinctions between the present invention and Chu et al. which follow are being made to expedite the prosecution of this application and without prejudice to applicants' right to show that Chu et al. is not prior art to them under any of the provisions of §102.

Independent Claim 51, which was rejected based on Chu et al., calls for an athermal optical device which comprises a positive expansion optical component affixed to the upper surface of a negative expansion substrate at at least two spaced apart locations. Dependent Claim 53 specifies that the component is a waveguide. Put simply, the Chu et al. reference does not disclose or suggest a negative expansion substrate, as required by each of these claims.

Chu et al.'s goal is to produce an athermal waveguide. However, their approach is completely different from applicants' approach. In particular, rather than mounting their waveguide to a negative expansion substrate, Chu et al. mount their waveguide to a positive expansion substrate and then design their waveguide so that changes in its optical properties as a function of temperature will balance the positive expansion of the substrate.

To do this, they use Ta_2O_5 for the core the waveguide, SiO_x for the upper cladding, SiO_2 for the lower cladding and Si for the substrate. SiO_x and SiO_2 have indices of refraction which increase with increasing temperature, while Ta_2O_5 has an index which decreases with temperature.

To obtain an athermal system, Chu et al. perform the following analysis. First, in their equation (2), they define the optical path length of their waveguide as:

$$S = n_{eff} L \tag{2}$$

where n_{eff} is the effective index of refraction of the waveguide and L is its length.

Then, in their equation (3), they obtain a normalized expression for the variation in optical path length with temperature:

$$\frac{1}{L}\frac{d(n_{eff}L)}{dT} = \frac{dn_{eff}}{dT} + n_{eff}\frac{1}{L}\frac{dL}{dT} = \frac{dn_{eff}}{dT} + n_{eff}\alpha_{sub} \tag{3}$$

where "α_{sub} is the thermal linear expansion coefficient of the Si substrate." (Chu et al. at page 215.) This equation only contains the linear expansion coefficient of the Si substrate and does not include the linear expansion coefficients of the SiO_x, Ta_2O_3, and SiO_2 layers making up the waveguide. Chu et al. explain why this is done as follows:

> The thermal expansion of the other dielectric layers was ignored. This is because the thickness of each individual layer is much thinner than that of the substrate. Therefore, the expansion along the cavity direction is primarily dominated by the Si substrate. (Chu et al. at page 215.)

Finally, Chu et al. explain their approach for achieving athermalization as follows:

> The athermal condition of the waveguide occurs when Eq. (3) equal zero. Therefore, we can design a temperature-independent waveguide by choosing a suitable combination of α_{sub} and dn_{eff}/dT. As one can see from Eq. (3), the value of dn_{eff}/dT must be negative. (Chu et al. at page 215.)

This approach has nothing to do with using a negative expansion substrate, as required by Claims 51 and 53. Indeed, when Chu et al. write that "dn_{eff}/dT must be negative," it is because in their system α_{sub} (the linear expansion coefficient of the substrate) is always positive. Plainly, a positive expansion substrate cannot be said to anticipate a claim which calls for a negative expansion substrate. Accordingly, applicants respectfully submit that the Examiner's rejection based on Chu et al. should be withdrawn.

III. <u>The §103 Rejection</u>

In the July 30th Office Action, the Examiner rejected Claims 60-61 under 35 USC §103(a) based on MacDonald et al., U.S. Patent No. 5,367,589. Again, applicants respectfully traverse this rejection.

The MacDonald patent is concerned with the packaging of an optical fiber and, in particular, to the packaging of an optical fiber in which a

grating has been written. In terms of thermal expansion coefficients, MacDonald distinguishes two cases: (1) the case where the coefficients of thermal expansion of the fiber and the package are the same; and (2) the case where the thermal expansion coefficients are different. The first case is used to minimize the effects on the fiber of a change in temperature and the second case is used to change the center wavelength of the grating:

> The optical fiber and the sleeve are made of materials with coefficients of thermal expansion that are the same or different. If the coefficients of thermal expansion are the same, the package protects the fiber from certain strains brought about by a change in temperature that would otherwise result if the package and the fiber were made of different materials. However, by selectively mismatching the coefficients of thermal expansion of the package and the fiber, a change in temperature can be used to bring about a desired change in the wavelength of a grating written in the fiber. (MacDonald patent abstract at lines 5-17.)

As discussed in the MacDonald patent, the thermal expansion coefficient of a fused silica fiber is about $+0.55 \times 10^{-6}/°C$. (MacDonald at column 6, lines 45-46.) Thus, in accordance with MacDonald's first case, the package for the fiber should also have a thermal expansion coefficient which is about $+0.55 \times 10^{-6}/°C$. That is, to minimize the effects of a change in temperature, MacDonald uses a material having a <u>positive</u> coefficient of thermal expansion.

Applicants' Claim 60 (as amended) and Claim 61 each requires the use of a material having a <u>negative</u> coefficient of thermal expansion for thermal compensation. Thus, applicants' claimed invention is the direct opposite of MacDonald's disclosure. Under these circumstances, applicants respectfully submit that the subject matter of Claims 60 and 61 would not have been obvious to a person of ordinary skill in the art from MacDonald's first case.

MacDonald's second case, i.e., the case where the package has a different coefficient of thermal expansion than the fiber so as to change the center wavelength of a grating written in the fiber, also does not disclose or suggest applicants' invention. No where in connection with this case (or in connection with the first case) is there any discussion of the use of a material having a negative coefficient of thermal expansion. Rather, for the change-the-center wavelength case, MacDonald recommends the use of metals, such as, aluminum:

> [I]f a change in temperature is desired to bring about a greater change in wavelength, the package is made of a material, e.g. a metal such as aluminum, with a coefficient of thermal expansion that is substantially different [from] the coefficient of thermal expansion of the fiber. (MacDonald at column 7, lines 61-66.)

As set forth at column 6, lines 47-51, of MacDonald, aluminum has a coefficient of thermal expansion of $+2.3 \times 10^{-5}$/°C, i.e., a strongly <u>positive</u> coefficient. Plainly, this disclosure of MacDonald does not disclose or suggest the use of a material having a negative coefficient of thermal expansion.

In view of the foregoing, applicants respectfully submit that MacDonald does not disclose or suggest the use of a material having a negative coefficient of thermal expansion to achieve thermal compensation either explicitly or inherently. Accordingly, withdrawal of the Examiner's §103 rejection of Claims 60 and 61 is respectfully requested.

IV. <u>Conclusion</u>

Based on the foregoing, applicants believe that this application is now in condition for the declaration of an interference with Fleming et al., U.S. Patent No. 5,694,503. As set forth in their April 30, 1999 Response to Restriction Requirement and Submission Under 37 CFR §1.607(a),

applicants believe that the count in such an interference should be Claim 61 of this application, which reads:

Claim 61 -- Proposed Count

In an apparatus having a fiber grating affixed to a device where the device provides thermal compensation to the fiber grating, the improvement wherein the device comprises a material having a negative coefficient of thermal expansion.

Reconsideration and the declaration of an interference based on this count are respectfully requested.

Respectfully submitted,

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